



# Leak Detection System



▶ **1997**

NASA space shuttle hydrogen sensors demonstrated on STS 95 and 96



▶ **1998**

NASA X-33 RLV program validated hydrogen safety system MSFC STTR with Case Western Reserve University



▶ **1999**

NASA Hypersonic X-43 validated hydrogen safety sensors MSFC STTR with Case Western Reserve University



▶ **2000**

International Space Station hydrogen sensing system included on the water processing O<sub>2</sub> generator



▶ **2001**

Helios aircraft collaborative effort with AeroVironment and DFRC



▶ **2003**

Ford Model U—Standard Hydrogen, Inc. (spin-off company) provides comprehensive hydrogen monitoring system

- KSC SBIR for sensor technology to detect hydrogen leaks
- \$1.6M STTR Phase 3 follow-on effort from GRC to further develop next-generation hydrogen and oxygen miniaturized leak detection systems

- \$700K Space Act Agreement with Glennan Microsystems/ Ohio State University for High Temperature Electronic Nose
- Received the R&D 100 Award in 2005

Aeronautics, Space Operations, and  
Exploration Systems Mission Directorates

NASA Glenn Research Center  
Gary Hunter • 216-433-6459

**MAKEL**  
ENGINEERING

Makel Engineering, Inc.  
Darby Markel • 530-895-2770